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ENVIRONMENTAL MEDICINE[1]

By ALFRED C. REED, M.D.

PROFESSOR OF TROPICAL MEDICINE, UNIVERSITY OF CALIFORNIA, AND DIRECTOR OF PACIFIC INSTITUTE OF TROPICAL MEDICINE

Good health in man and woman, dear my lord,
Is the immediate jewel of their souls;
Who steals my purse, steals trash;
But he that filches from me my good health,
Robs me of that which not enriches him,
And makes me poor indeed.

THUS we paraphrase Othello.

Under the teachings of the great pathologist Virchow, who died in 1902, medical science has been dominated by the conception of cellular pathology and cellular organization of living bodies. Out of cells, tissues were constructed. Out of tissues, organs were constructed. All the organs, and nothing more, made up the organism. Analysis was enthroned as a god. The whole was established as the exact sum total of all its parts. All the functions of the whole were derived from its elementary components. Medical particularism held the field, as behaviorism and autonomic materialism ruled supreme.

Gradually, however, there has come a change in emphasis which we may call the outworking of philosophic method in the domain of science. The change is not complete, but as it progresses, we can hope that the inherent values of analysis and the cellular organization will be carried over and completed in the broader and more difficult conception of organic unity and functional synthesis. Thus only can we treat of man as a whole being, as an organism or an individuality, if you please, who is greater than the sum total of his parts. Speaking of society, Pareto[2] puts it in these words, "The fact that we deal with *individua* by no means implies that a number of individua taken

[1] Commencement address delivered at Pomona College, Claremont, California, June 17, 1935.

[2] Wilfredo Pareto, "The Mind and Society," Vol. I, p. 32, 1935.

together are to be considered a simple sum. They form compounds which, like chemical compounds, may have properties that are not the sum of the properties of their components." I think this trend in scientific medicine may be called the synthesis of man. Once more it exalts the service of being over the worship of doing. Its wider perspective brings into focus two principles among others, to whose consideration I invite your present attention.

The first of these principles is that alien races and cultures have important contributions out of their own thinking and their own experience, for the construction of a constantly improved understanding of man himself. Truly the proper study of mankind is man.

The second of these principles involves the solution of the indeterminate equation, man plus environment = X. I want to propose a somewhat different method for the solution of this equation. It is necessary to consider man as an organic unity in relation to his environment. This is the present formulation of the objective of medical science. Health has never been defined adequately because it is so variable a quantity. It can perhaps best be taken as the state of the complete human organism in relation to its environment. The consideration is then no longer limited to diseases which may be merely a disproportion between processes in themselves normal. All questions of normalcy thus become relative. The rightness and wrongness of symptoms and processes become matters of pragmatic definition. The field of inquiry broadens and permits research in any of its domains, but all research becomes an inherent part of an attempt at constantly better understanding of man himself. Separate analyses of small areas become part of the great synthesis of man's place in nature, his ability to control or modify nature and to adapt himself to nature. Of such materials must be constructed the eventual temple of Hygeia in which each person becomes a necessary building stone and whose sum total represents the highest attainment of humankind because it is based on, and is indivisible from, the highest possible state of health.

When we inquire as to the difference between man and his environment—when we seek the limits of the one with reference to the other—the situation becomes involved. Clear separation and demarcation is difficult, often arbitrary, but invariably necessary. Space and time enter with confusing force. For the purpose of solving our equation, we can not entirely follow Kant and make these categories purely subjective, nor can we completely accept the Cartesian axiom of an indefinable unitary and basic individuality. Our goal of synthesis requires recognition of the inter-extension of organism and environment. As Professor Livingston[3] says:

> . . . it is always true that many features of an organism are continuous with corresponding features of the environment; there is always interchange of material and energy between these two portions of a more complete system, and organism influences environment; while environment influences organism. Consequently we can not expect to proceed far toward an appreciative understanding of the ordered vital weft of internal features without giving equal attention to numerous features of the just as thoroughly ordered but different environmental weft.

Our inquiry can then no longer be limited to the particularistic study of man himself, as under the old domination. We are forced to consider man as a whole organism. To do this we are equally forced to consider his environment in all its aspects. This broad field of inquiry makes up what may be called environmental medicine. But the program must be clarified by a few clear definitions. Medicine means the prevention, cure and alleviation of disease. The doctor is merely the teacher or intellectual leader. Treatment, or therapy, comes from a word meaning servant. Whatever serves man is medical treatment. Health is based on a Saxon word meaning wholeness or soundness. Hippocrates truly said that whatever belongs in the domain of wisdom is contained in medicine. From this same idea, Cartesius drew the conclusion in broad terms that "if man can be ennobled at all, it can be accomplished by medicine alone." Following the scientific method, alleviation, cure and prevention must depend on diagnosis, which simply means thorough knowledge. Virchow's day is past, of which Abraham Jacobi said, "The perfect patient is the one who is diagnosed by Skoda and autopsied by Rokitansky." That day is past because it is being lost in the greater brilliance of this conception of environmental medicine, where man is more than an objective organism, where man and his environment are inextricably intermixed, and where the understanding of man requires understanding of the greater whole of which he is an integral part.

A complete discussion of environmental medicine would far exceed our present limits. But we can illustrate briefly the importance of environment on the health of man by reference to the field of tropical medicine.

The term "tropical medicine" is a peculiar instance of a name which can not be successfully improved or replaced, and whose exact meaning is lost in its historical connotations. By it we mean the practice of medicine in warm climates. Systematic study of dis-

[3] Burton E. Livingston, SCIENCE, 80: 569, December 21, 1935.

ease requires study of the disease cause, of its means of transfer or spread and of its human recipient. The natural history of disease is modified profoundly in all these particulars by climatic conditions. Climate is one factor in geography. In the words of the Century Dictionary, geography is the "science of the description of the earth in its external aspects, dealing with its forms and movements, physical features, climate and products, inhabitants, and natural and political divisions, and the population, industries, etc., of the various countries." When we delineate this field more exactly by the term "medical geography," we have made it include in the broadest sense man's environment in relation to health or environmental medicine.

Mankind was cradled in the tropics, and thither he now must return for food, for power, for residence. This it is which underlies the fast-growing importance of tropical medicine. But in the tropics also, history has shown at their worst the tremendous catastrophes of war, famine, epidemics and natural disasters. The burdens of these also are carried by tropical medicine. Here the extra-human biologic world reaches its greatest and most complex development, and therefore interacts most potently with man. This includes primarily animals, fish, insects, plants and various organisms capable of parasitizing man. These affect man through the agencies of food supply, animal reservoirs of disease, direct carriers of disease, nuisances and direct attack. All these health hazards are sharply focussed, highly active and much accentuated in warm climates. Improper food supply brings a host of evils, such as pellagra, sprue, beriberi, scurvy and nutritional foundations for many other conditions. Animals have an intimate and fundamental relation to human disease as carriers and as natural reservoirs of infection. This is seen, for instance, in the case of yellow fever, plague, hydrophobia and parrot fever. To illustrate animal carriers of disease, we have only to recall the rôle of mosquitoes in malaria and yellow fever; of lice and ticks, in typhus and relapsing fevers; and of rodents in rat-bite fever and plague. The animal world gives many illustrations of nuisances from the human standpoint and some of these are real health hazards, as in the case of interference with rest due to verminous insects, and secondary infections gaining access to the body through insect and other animal bites.

In warm climates the health status is influenced by environment in the maximum variety of ways. Let us look at some of these specific features of environmental medicine in the tropics, fitting all of them into the equation, man plus environment = X.

We consider first the major elements of climate itself, air pressure, humidity, temperature, insolation, magnetic and radioactive fields, winds. These are closely tied in with the movement of ocean tides and with land forms and land-sea balances. Out of these is compounded the average state of the earth's atmosphere, which we call climate. Here is one of the controlling environmental factors with reference to man's state of health. The growth, quality and variety of vegetation affects quality and quantity of food supply and the type of indigenous culture. The insect population is to a great degree dominated by climate. Man's physiology is directly affected. The evenness of equatorial climate, with its minima of physiologic contrasts and stimulation, furnishes the bases for that chiefest enemy of human progress, monotony. More immediately we see the same thing illustrated in the severe nervous disturbances which follow the "50 day wind" of Persia and the north wind of the Gran Chaco. A monotony of good things is as soporific and deadening as a monotony of adverse things. Man's very consciousness depends on contrasts. Variability is the secret of physiologic rhythm and of biologic life. California is perhaps over-stimulating in its geographic contrasts and its intense variability. As a consequence we see cults, quacks and harebrained inventions where mental discipline is deficient; and where mental discipline is adequate, we see the highest advance in the lines of social ideas, science, politics, religion and the intellect. The great apparent exception to all this is Egypt, a section of the Sahara desert with a river flowing through it. That river, by its unvarying overflow, insured reliable crops, a factor, in desert country, which counterbalanced the monotonous climate and geography.

Low latitudes are usually associated with the rain forests, humid air, cloudiness, heat and exuberant biologic growth of the equatorial zone. But outside of this area, both north and south, the earth is belted with deserts. Abrupt changes in character of population and culture appear. Disease takes on new forms. The human economy is adapted to dryness, dust and glare. Food habits bring different health problems. Nomadic life, milk foods and animal culture become possible and necessary. Due to change in climate, the cultus of the desert has overflowed in at least two great historical movements which have had untold influence down to the present. The first of these was the westward march of Islam under the Caliphs, extending finally into Spain. The second was the movement of the hordes out of central Asia into Europe, China and India. As a result China incorporated Mongolian traits in government, social life, economics and racial temper. Russia for over 200 years was ruled by Tartars with a lasting intermixture of Asiatic oriental blood. In India, while the Moslem impact received a great impetus with Mahmoud of Ghazni in the year

1000, it became completely dominant under the 300-year rule of the Moguls or Mongols. The tremendous social changes there are illustrated by the development of the zemindar landlord system, which caused the basic agrarian problem of India and has only recently given promise of solution by return to a modified Hindu village communism. Another nearly insoluble social problem is seen in the bitter animosity between the 80,000,000 Moslems of north India and the 220,000,000 of the Hindu religion. These two historical problems lie at the root of India's complex difficulties to-day. Both are factors of environmental medicine and of primary concern for the health status of that great country.

The economic type of culture is in general a product of hereditary social and geographic factors. The rain-forest dwellers of the Congo and Niger basins and the southern fringe of eastern Asia have a fairly fixed location, considerable isolation and rudimentary agriculture. Insects and diseases interfere with animal husbandry. The negroid and Malay inheritances prevent intellectual advance. All the environmental conditions retard cultural improvement. Equatorial Africa has been largely denuded of domestic animals by infections carried by the tsetse fly, which has also depopulated entire districts by sleeping sickness. Yet this destruction of live stock saved central Africa in the seventh century from occupation by the Moslems, since even the desert-trained Arabs could not take their horses south of the Sahara. The tsetse fly turned Islam north into Spain. And the tsetse fly is a product of geography.

Ocean currents are another geographic agency of untold importance in human affairs. The story of the Japan current, flowing from the breeding ground of hurricanes in the Malay Islands and making China, Japan and our own West Coast habitable, is matched by the saga of the Gulf Stream, starting from its own nest of hurricanes in the Caribbean and giving sustenance to the cultures of the north Atlantic and Mediterranean. Islands and coastlines shared in this influence and contributed their full geographic share to the glories of Greece and Rome. Again the growth of great cities has been a function of geography and pays due tribute to the importance of environment in moulding man's habits and health. The trend to cities characterizes the modern epoch. The geographic history of London, Calcutta, Tokyo, Shanghai, Manila and New York throw added light on the powerful influence of environment on medicine.

A different kind of health influence is seen when we turn to the eating and drinking habits of the races. Empirical habits may be good or bad. Undoubtedly China owes no small part of her longevity to chopsticks and boiling hot tea. By contrast we see the Arab, not even observing the Koranic permission to wash in sand when water can not be had, eating from a common dish directly with his well-weathered fingers. The half-rotten meat of the mid-African zone introduces digestive hazards well matched by the parasites swallowed in half-rotten dried fish by the Chinese and raw, even live fish, by the Japanese.

The wheat-eaters of north China are in strong contrast to the rice-eaters south of the Yang-Tze River. Freshly fixed nitrogen of volcanic origin is washed by torrential rains into the lower valleys of Java to make possible one of the densest populations known, supported by the rich rice paddies and the vitamins of tropical fruits. The liking of rice-eaters for over-milled rice results in beriberi when other dietary balances are lacking. Sprue declined rapidly in Ceylon when the foreign population began to depend less on imported canned goods. Medical science made possible food preservation, which has become a complex and highly capitalized industry, so that tinned goods and concentrates may still be balanced and safe. Nature has kindly provided a rich assortment of spices to stimulate digestive organs suffering from the monotony of tropical dietaries, and their over-use easily leads to disorders of the liver and intestinal tract, already inclined to passive congestion and inflammation. These are but a few of many illustrations of the influence on health of geographic eating and drinking habits.

It is probable that every race has invented or adapted some type of poison that suits it best and pleases it most. We have our alcohol, tobacco, coffee and other favorite drugs. The Andean peoples have their coca leaf. Asia has its opium. Mexico has provided marihuana. The Pacific Islands and Malaya have demonstrated the brotherhood of man by refinements of alcoholic manufacture. The southern half of Asia, the great eastern islands and a third of Africa are delighted addicts of the betel nut. This last is one of the most highly developed, wide-spread and ingenious of man's attempted improvements on nature. In ancient Turkestan, hemp was a fiber plant valued for its many uses. Transported across the great mountains into the hot, low plains of north India, it took on or was found to have peculiar narcotic properties. Its crude stems and leaves make the favorite social drink of the country. Its more purified portions are smoked, drunk and chewed with betel nut, as ganja. Its purified sap is charas or hashish. The betel nut chewer concocts a mixture of ganja, fresh lime and assorted spices, with the sliced fruit of the areca palm, called betel nut, rolls up the mass in a succulent pepper leaf and stuffs it in his mouth. The bright red saliva is a feature of the eastern landscape. Indian hemp in extreme cases causes a peculiar insanity,

various psychologic disturbances and of course general physiologic symptoms. Obviously all drug habits are closely tied in with personal and public health and have their foundation in environmental conditions.

Few departments of human life have a more thrilling story or one more closely interwoven with man's advance than communications. The romance of transportation is linked with all the means of spread available for ideas and knowledge. Printing, telegraph, telephone, radio and transportation beneath and on the water, by land and by air—it is the story of civilization. Transport problems are always fresh and always urgent. In 1571 Queen Elizabeth rode in a coach to open Parliament, the first time an English sovereign rode in a state coach. Londoners called the new contraptions "hell carts." Ellison Hawks[4] has written a thrilling description of "The Romance of Transport." Distribution of goods and transfer of persons control famines, relieve disasters, determine wars, promote government and cause or prevent economic crises. Commerce is no more dependent on communications than is medicine. Preservation and improvement of health status go hand in hand with good communications. And communications are a direct product of man's ability to control or modify his environment.

Mankind is indeed incurably religious, whether he shows it by empirical fear of nature, by formulated systems or theories of divinity or by worship of a social organization as in Russia. It is to be expected, therefore, that religion will be fundamental, but not of necessity helpful, in all ages and among all nations in the building of disease control and health improvement. And so we find it in fact. Animism, juju and magic so confuse or identify effect and cause that the bases of sanitary practice and preventive medicine can not be laid. Islam offers many strong features in its program and makes medical science contend with fatalism and colossal fanaticism. It shares in the sanitary guilt of unsanitary pilgrimages, which have been sources of anxiety to medical science for many ages, equally in Chaucer's time, the crusades and the modern hadj to Mecca. The pessimism of Buddhism seeks escape from the problem of life by abolishing desire for gratification of the senses, for personal immortality and for prosperity. Such a philosophy has immediate medical connotations.

Hinduism also has its pessimism and its path of escape, by denying reality and teaching the doctrines of rebirth and of Karma. The present state of man is thus unreal and unchangeable, and any effort at change becomes a sin. The doctrine of rebirth leads to callous indifference to the animal world with immediate and tragic consequences in regard to needed food supplies and control of bacterial and animal parasites. Carried to its logical or illogical extreme by the sect of the Jains, it teaches that there is a soul in every object and that the path of escape is only by complete abnegation. Libraries can hardly contain the literatures of the world's religions. Little reflection is needed to realize that religious belief may be the strongest of all friends of medicine and health or the most implacable of all enemies. We are taught to support complete freedom of religious belief and we must of necessity grant the same privilege to other countries as to our own. Persuasion, comparison and knowledge are the ultimate weapons. Yet these are slow and often ineffective against religious strongholds which are hostile to medical science. We see this in the United States of America, even as in India, Turkestan or Africa. Yet we can securely rely on the ultimate victory of truth, and the practical lesson is to add patience to the qualities necessary for success in the long war between medicine and disease. There is a lesson here also for the spread of Christian missions with their invaluable content of medical teaching and practice. Again comparison, persuasion and knowledge are the tools and the object must not be an exotic and foreign-controlled system, but the growth of a native, indigenous system, adapting and using in its own way the new principles learned, and free to develop them in the line of native history and culture.

In the tropical world, man's medical defences are undermined by insidious and persuasive influences, while at the same time the direct agents of disease are multiplied and deadly. Epidemic diseases have laid low ancient empires. Angkor, Egypt, Greece and Rome bowed to the pestilence that walketh in darkness. Ten thousand times 10,000 have fallen before those great captains of death, plague, dysentery, typhus, cholera, malaria. Death comes quickly in low latitudes, borne on the wings of mosquito and fly, concealed in the vermin of rodents, coursing in the blood of man and beast alike. Only by superior knowledge and keen medical weapons can man fend off the attacking hordes and grow strong on their discomfiture. Vaccine, serum and drug—the sanitary engineer, the public health officer and the protection of personal hygiene—are all necessary. For man must again use the tropics, and what he can not conquer, he must use by adaptation.

One of the most difficult problems of environmental medicine is the acclimatization and adaptation of the white man in the tropics. Of the discussion of this, too, there is no end. Climatic conditions bring monot-

[4] Ellison Hawks, "The Romance of Transport," Thomas Y. Crowell, 1932.

ony and lack of stimulation physiologically. The easy tendency is an attempted compensation in spicy food and strong drinks. A vicious circle arises, increased by insufficient exercise. Predisposition is established for infectious, contagious and deficiency diseases.

Man's greatest health enemies are ignorance, indifference, poverty and certain religious systems. Contact with a different and often inferior native race leads to mental isolation and distorted perspectives of social values. Poor communications and enervated physiology weaken moral stamina and lower social and intellectual standards. Mental slackness follows on physical slackness. Latent weaknesses become patent. Adaptation and acclimatization require clear understanding of the dangers, improved communications and rigid maintenance of personal standards. The British dinner jacket has become a symbol of morale.

Understanding of the environment is necessary to avoid disaster. Food, clothing and housing must combine local facilities and customs with the requirements of medical knowledge. Balance of work, rest, play and intellectual interests must be attained. Mental and sex habits must be coordinated with the program. Such complete control of and adaptation to tropical surroundings has seldom been fully achieved. But in proportion to the completeness of this adaptation rests the ability of the white man to live in the tropics. It is becoming easier as medicine leads the way. The culture of higher standards must always prevail by absorbing the proved virtues of the indigenous native culture. Such synthesis is the hope of the future, in world civilization, in religion, in all human activities.

The value of organized study in the field of tropical medicine has been recognized by the governments of England, Germany, Italy, France, Belgium and more lately of the United States. The army and navy medical corps and the federal Public Health Service have a brilliant record worthy of the pride of every American. The field, however, is broader than these services, and to-day we find some thirty-five universities, numerous public health bodies, various foundations and other government agencies actively engaged in the study and practice of tropical medicine. The American Academy and the American Society of Tropical Medicine correlate and strengthen all these activities under the American flag, worthily matching similar organizations abroad. The practical work is in three divisions, research, clinical care and study of the sick, and education of doctors, nurses and non-medical persons. The three chief geographic centers are in New York, New Orleans and San Francisco. In the University of California, the Pacific Institute of Tropical Medicine is a cooperative Pacific coast enterprise, supported by commerce which recognizes the foundation necessity of medicine, which has community pride and which joins with the American government in recognizing the international values of tropical medicine in joining nations in a program of common advantage.

Four thousand five hundred years before Christ, the physician Iemhetep in Egypt served the third dynasty of pharaohs. His name is translated, "He who comes in peace." His successors to-day are ambassadors of peace. They open international doorways of friendship. Those dedicated to this service find satisfaction and reward beyond the measurement of gold and more lasting than can be expressed in words.

OBITUARY

HENRY FAIRFIELD OSBORN[1]

OUR beloved former president, Henry Fairfield Osborn, died suddenly of heart failure at his home at Garrison-on-Hudson, on Wednesday, November 6, 1935, at the age of seventy-eight years. It is exceedingly difficult to express adequately our sorrow in losing this steadfast friend and great leader. His human contacts were so numerous and so uniformly helpful to others that a great many people will deeply mourn for him. In fact, his good deeds on every side were so manifold that we know not where to begin. Nevertheless we must attempt a brief outline of his life, as follows:

He was born on August 8, 1857, at Fairfield, Connecticut, the son of William Henry Osborn and Virginia Reed Sturges Osborn. His ancestry on both sides was of the best and his very able and devoted parents left nothing to be desired in the influences that moulded his childhood. While he was still quite young (1881) his father built a house, "Wing-and-Wing," near his later residence, "Castle Rock," at Garrison, N. Y., overlooking the Hudson River, opposite West Point. In this delightful home and environment the young Fairfield early showed his interest in natural history. As a student at Princeton he came under the influence of the famous Dr. McCosh and was so much attracted by the subject of philosophy that he undertook several studies in psychology and philosophy which were published as brief papers at intervals from 1880 to 1884.

Meantime, however, through Professor Guyot of Princeton, he became interested in paleontology and in 1877 he, together with his friends W. B. Scott (who was destined to remain as his life-long colleague) and Francis Speir, Jr., organized and carried to a very

[1] Read at a meeting of the Scientific Staff of the American Museum, on November 7, 1935.

successful conclusion the Princeton scientific expedition of 1877; this expedition explored the Bridger Basin in Wyoming and brought back many important specimens of new and little known Eocene mammals. From 1878 to 1880 he worked as a graduate student and instructor (1881–1890) at Princeton. In those days evolution was the burning topic of interest in all universities and, before paleontology had supplied the direct evidences of evolution, embryology and comparative anatomy were looked to as its principal supports. Osborn at that time, as later, saw that all three sources of evidence should be studied together.

In 1879–80, therefore, he went to England for advanced graduate work at Cambridge University with the great embryologist Balfour. Later he went to the Royal College of Science, where he became the pupil of T. H. Huxley and ardently studied comparative anatomy under that inspiring teacher. We see in his early study on the foetal membranes of the opossum and other marsupials signs of his ability to choose subjects of strategic importance. The same is true of his studies on the origin of the corpus callosum of the mammalian brain; in his rather extended paper on the principal fiber tracts of the brains of amphibians he opened up a line of investigation which has been carried on by, among others, Professor C. J. Herrick, who gladly acknowledges the importance of Osborn's pioneer studies. In fact, between 1883 and 1887 comparative neurology may be said to have been his principal subject and, with the assistance of Dr. Oliver S. Strong, he planned to write a general work on comparative neurology.

Gradually, however, his papers in vertebrate paleontology became more numerous and after another extended residence in England he completed his memoir on Mesozoic Mammals (1888), which again demonstrated his ability to choose a subject of major importance and to extract from it far-reaching results. For it was the Mesozoic Mammals that carried back the history of the mammalian molar teeth to a very distant date, when the triangular or so-called tritubercular molar crown was in its initial stages. He therefore endorsed Professor Cope's theory of the origin of the tritubercular molar, adding many original evidences and observations of his own and early developing an ingenious system of naming the principal cusps of the upper and lower molars, which system has since been adopted by the paleontologists of the world. While giving every due credit to Cope, he proceeded to apply his own nomenclature in detail to the complex molar patterns of ungulates and showed how, with this tritubercular key, as he called it, one could unlock and open up the most complicated molar patterns, analyzing their parts and reading the history of the group.

In 1891, through the cooperation of President Seth Low of Columbia University and of President Jesup of this museum, Professor Osborn was invited to take up his residence in New York and to become, on the one hand, Da Costa professor of zoology at Columbia University and, on the other, founder and curator of the department of vertebrate paleontology in this museum.

At Columbia he was the leader in organizing the new department of zoology. With the assistance chiefly of Drs. E. B. Wilson, Bashford Dean and Oliver S. Strong, he soon developed a very progressive and successful department. During this period he founded the Columbia University Biological Series and brought out therein his book "From the Greeks to Darwin," which attracted wide attention. He also arranged the publication in the same series of Willey's "*Amphioxus* and the Origin of the Vertebrates," Dean's "Fishes, Living and Fossil" and Calkins's "The Protozoa." For almost a decade he served actively as dean of the School of Pure Science, and as the time came nearer for Columbia to move to its new site at Morningside Heights, he became responsible for the planning of the lecture rooms, laboratories and offices of the department of zoology in Schermerhorn Hall, the cornerstone of which was laid in 1896. Meanwhile he was conducting courses in neurology, comparative anatomy and paleontology in the department. Drs. Gary N. Calkins, J. H. McGregor, Henry E. Crampton and the present writer were all his own graduate students. About 1903 he began to transfer to the museum the greater part of the lectures and laboratory work of his graduate courses "Evolution of the Vertebrates" and "Mammals, Living and Fossil." In 1907 he handed over these courses to the writer for further development and they are still being conducted at the museum. His regular teaching work at Columbia ceased in the year 1910, when he was appointed research professor in zoology and generously turned back his salary into the department.

Chiefly through his efforts the museum acquired (1895) the private collection of fossil vertebrates which had been amassed by his friend, Professor E. D. Cope of Philadelphia. He soon gathered around him an able staff, Dr. J. L. Wortman as assistant curator, Mr. Adam Hermann as chief preparator, and others. Then under his vigorous and efficient direction was begun that great series of field explorations for fossil vertebrates which has never ceased to this day. To make a very long story short, the building up of the department of vertebrate paleontology through forty-five years of his continuous activities is regarded by some as his greatest single achievement.

He derived great inspiration and enjoyment from his numerous paleontological field trips, especially in

the western states, but also in Egypt and Mongolia and in his trip around the world.

At the time of his death he was the author of 940 articles, papers, books, monographs, etc., listed in his bibliography. It is obviously impossible to refer in detail to this astonishing output; but it seems very safe to state that among his most important contributions to science were the following:

(1) His initial studies on the origin of the corpus callosum of the mammalian brain;

(2) His memoir on the Mesozoic Mammals;

(3) His numerous contributions to the study of the evolution of mammalian molar teeth to and beyond the tritubercular type;

(4) His many important papers and monographs on the fossil rhinoceroses, titanotheres, horses and proboscideans;

(5) His great text-book on "The Age of Mammals."

With regard to the theory of evolution, his outstanding principles or laws, as he called them, include the following:

(1) The law of *continental and local adaptive radiation;*

(2) The law of *homoplasy* or parallel but independent evolution in related lines of descent;

(3) The law of *tetraplasy,* whereby evolution results not from the operation of single causes, but as the resultant of forces from four principal directions (external environment, internal environment, heredity, selection).

(4) The law of *alloiometry,* or adaptive modification of dimensions of the skull, feet or other parts, arising independently in different lines of descent.

(5) The law of *rectigradation,* or *aristogenesis; i.e.,* the gradual appearance during long ages of new structural units of adaptive value, predetermined in the germ plasm and in their initial stages independent of natural selection;

(6) The law of *polyphyly; i.e.,* the normal occurrence of many related lines of descent, derived eventually from a common stock, but coexisting throughout great periods of time.

Professor Osborn's contributions to science were recognized by his election as foreign member of the Royal Society of London, as honorary fellow of a long series of other distinguished societies in Great Britain, France, Belgium, Holland, Germany, Russia, Sweden, Italy and other countries of Europe; also of China, Persia, Argentina, Mexico, Cuba. In this country he was an active member of the National Academy of Sciences, of the American Philosophical Society for Promoting Useful Knowledge, the American Academy of Arts and Sciences, the New York Academy of Sciences and many others. He was president of the New York Academy of Sciences in 1898–99, and president of the American Association for the Advancement of Science in 1928. For many years he was chairman of the executive committee and later (1909–1924) the very active president of the New York Zoological Society. He was the recipient of many medals awarded in recognition of his scientific labors, including the Darwin Medal of the Royal Society of London, the Wollaston Medal of the Geological Society of London, the *Prix* Albert Gaudry, awarded by the Geological Society of France, the medal of the Pasteur Institute of Paris and many others.

In 1899 Professor Osborn became closely associated with President Jesup in the administration of the museum, and upon the death of Mr. Jesup in 1908 he was elected president of the Board of Trustees. From that day until his retirement to the position of honorary president in 1933, he carried a vast burden upon his strong shoulders. During this period, and thanks in large part to his able leadership, many buildings were added in response to ever-growing pressure of collections and exhibits. Undoubtedly not even he could have accomplished all this if he had not budgeted his time so effectively and concentrated so intently upon one thing at a time.

On the personal side, Professor Osborn was sincere, benign, urbane, without guile, very loyal in friendship and highly appreciative of loyalty in others, extremely helpful, especially to his students and assistants. He consistently respected the right of his colleagues and assistants to differ with him in the interpretation of scientific problems.

He loved young people and delighted in furthering their education along broad and thorough lines. His wife, Lucretia Perry Osborn, until her death in 1930, was at all times a most able and enthusiastic partner. His children and grandchildren survive to cherish his memory.

WILLIAM K. GREGORY

AMERICAN MUSEUM OF NATURAL HISTORY

SCIENTIFIC EVENTS

SUMMER WORK OF THE DIVISION OF GEOLOGICAL SCIENCES AT HARVARD UNIVERSITY

FORTY members and students of the Division of Geological Sciences at Harvard University were engaged in field work and half a dozen remained in Cambridge to do laboratory and office work. Studies were carried on in many states and countries, including Australia, Africa, Mexico, Chile, Argentina, Peru, Europe, New Mexico, Colorado, Montana, Texas, Min-

nesota, South Dakota, New Hampshire and Virginia. The largest groups worked in New Mexico, Montana and New Hampshire.

Five field parties, under the general supervision of Professor Kirk Bryan, carried on researches in New Mexico and Colorado, particular emphasis being given to the physiography. Professor Bryan spent the month of August visiting these field parties in New Mexico. In July he was at Fort Collins, Colo., investigating the geology of the archeological site now being excavated by F. H. H. Roberts, Jr., under the auspices of the Smithsonian Institution. In June he was in Minnesota studying the geological setting of the so-called "Minnesota Man" and also of a skeleton found at West Union, Minn., by Father Henry M. Retzek, A.M., '31.

Four field parties were in Montana. The study of the geology of the Highwood Mountains, which has been carried on as a Shaler Memorial Investigation under the supervision of Professor E. S. Larsen, Jr., was completed. William F. Jenks, working under the direction of Professor Russell Gibson, completed a two-year study of the geology of the Trout Creek area along the Montana-Idaho boundary.

Five field parties, under the supervision of Professor Marland Billings, '23, were at work in New Hampshire, giving special emphasis to the bed-rock geology.

Claude C. Albritton, Jr., A.M., '34, holder of the Woodworth fellowship, completed a detailed study of the Malone Mountains in Trans-Pecos Texas; Professor Billings visited him for two weeks. Lincoln R. Thiesmeyer, A.M., '33, Austin teaching fellow in geology, spent his second field season in northwestern Fauquier County, Va., and was visited by Professor Larsen for a week. Wallace de Laguna, 2 Grad., studied the ore deposits and general geology of an area at the southeastern end of the Wind River Range, Wyo.

The economic geologists were very busy. Professor L. C. Graton went first to Peru on consulting work, and then made a shorter visit to Braden, Chile. Professor D. H. McLaughlin returned from a half-year leave, in the course of which he visited many mining districts in Australia, Africa, Mexico and the United States.

Professor Charles Palache and Harry Berman, A.M., '35, made short trips to collect minerals at Amelia, Va., and the talc mines of Chester, Vt. The new x-ray laboratory for the study of the atomic structure of minerals was completed and in operation all summer.

Professor D. S. Whittlesey first went to Mexico, where he lectured, as a member of the faculty of the Seminar of the Committee on Cultural Relations with Latin America, on the "Geography of Mexico." He is now on a trip through Chile and Argentina, and will soon visit the west coast of Africa and the southwestern Hahara region. He is studying human geography. Harold S. Kemp, instructor in geography, spent the summer in the countries bordering on the Baltic and North Seas gathering material for a forthcoming book on the human geography of Europe.

Professors Daly, Raymond, Gibson and Larsen, although they did not do any extensive field work, were engaged in laboratory work and preparation of reports and books. Professor Mather served as director of the Summer School. Dr. L. Don Leet was at the seismograph station in Harvard, Mass., through the summer, writing a text-book on the principles of seismology and making a special study of dynamite blasts in the vicinity of Harvard.

THE GEORGE F. BAKER FELLOWSHIPS AT CORNELL UNIVERSITY

As an outgrowth of the benefaction of the late George F. Baker to the department of chemistry at Cornell University, the creation of one or more Baker Research Fellowships, with tenure of a year or possibly longer, has been authorized by the Board of Trustees. According to Dr. Jacob Papish, head of the department, the holders of these new fellowships "shall be young men of the calibre of national research fellows, capable of carrying on independent investigations of high quality."

Dr. F. H. Spedding, formerly national research fellow and the winner of the Langmuir Prize in 1933, is the first appointee. His investigations are dealing with the correlation between the absorption spectra of solids and of solutions and their physical and chemical properties. Dr. Spedding received the degree of B.S. in chemistry from the University of Michigan in 1925, and the master's degree in 1926; his doctorate was obtained at the University of California, under Dr. G. N. Lewis, in 1929. During 1930–32 he held a national research fellowship, and in 1933 he was awarded the Langmuir prize. During the past year he studied in Europe under a Guggenheim fellowship.

The funds for the new fellowships will come from the Baker lectureship in chemistry, which was founded at Cornell University by Mr. Baker in 1925 with an endowment of $250,000. The lectureship is filled in successively by men eminent in chemistry or in some related branch of science who are invited by the department of chemistry to lecture, each for one or two semesters, on some topic or topics within the lecturer's own special field of investigation. The present holder is Dr. R. A. Gortner, professor of agricultural biochemistry at the University of Minnesota.

Among Mr. Baker's other benefactions to Cornell is

the Baker Laboratory of Chemistry, built in 1922 at a cost of $2,000,000.

THE SUMMER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

THE forty-first summer meeting of the American Mathematical Society was held at the University of Michigan at Ann Arbor, Michigan, from September 10 to 13. The Mathematical Association of America, which met in conjunction with the society, held its sessions on Monday afternoon and Tuesday.

The principal feature of the meetings was the eighteenth of the series of colloquium lectures delivered under the auspices of the society, by Professor H. S. Vandiver, of the University of Texas, on the subject "Fermat's Last Theorem and Related Topics in Number Theory." Professor Vandiver delivered three lectures of an hour and a quarter each on Tuesday, Thursday and Friday afternoons.

On Wednesday morning, by invitation of the program committee, Professor G. Y. Rainich, of the University of Michigan, gave an address entitled "Remarks on Product Integrals and Their Applications to Geometry." On Friday morning, by invitation of the program committee, Professor G. T. Whyburn, of the University of Virginia, gave an address entitled "On the Structure of Continua."

Of the shorter papers read before the society at its various sessions, thirty-five were presented in person and fifty-one by title.

The local committee arranged a delightful program for the visiting mathematicians and their friends. Wednesday afternoon was featured by an excursion to Dearborn, where mathematicians were free to visit Ford's Greenfield Village or to visit the Ford factory. On Thursday evening the banquet of the mathematical organizations was held at the Michigan League. Professor H. E. Buchanan acted as toastmaster. The speakers were: Dean E. H. Kraus; Professor H. L. Rietz, representing the Institute of Mathematical Statistics; Professor D. R. Curtiss, representing the Mathematical Association; and Professor J. D. Tamarkin, representing the society.

MARK H. INGRAHAM
Associate Secretary

THE THIRTY-FIRST ANNUAL NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE annual geological excursion of the New England colleges for 1935 was held on October 11 and 12 under the auspices of the Department of Geology of the Massachusetts Institute of Technology. The leaders were Professor Frederick K. Morris, Dr. W. H. Whitehead and Mr. C. Pearsall.

The party assembled on Friday at 1:00 P.M. in the yard of Technology and proceeded to the Blue Hills Reservation. Here the afternoon was spent in studying phases of the Blue Hill porphyry and the conglomerates of the Norfolk basin to the south. The gray Pondville conglomerate at the base of the sedimentary series was seen in several localities and its passage southward into the red Wamsutta conglomerates noted. As the contact with the porphyry was approached the conglomerate contained a higher percentage of porphyry boulders until at the contact little or no foreign material was seen. The porphyry near the contact showed a tendency to spheroidal weathering. These facts seemed to indicate that the conglomerate near the contact was residual or only slightly transported. The Blue Hill porphyry was seen in several phases which seemed to intrude each other, each stage sending stringers into earlier intrusions which had cooled to the stage of a jelly.

A conference was held on Friday evening at Technology at which the theories of intrusion of the igneous bodies of the region were presented by Professor Morris and discussed by other members of the excursion.

Friday was spent in the study of the igneous rocks of the Middlesex Fells. The first stop was at an exposure of the Medford diabase where a discussion as to pre- or post-glacial occurred. The proponents of post-glacial action believed that the composition of the rock and burial were responsible for the unusual amount of weathering.

The rest of the day was spent in the study of the relations of the Dedham granodiorite and the overlying Lynn volcanics. The evidence is believed by some to indicate that the granodiorite was the younger of the two formations and was intruded into the volcanics. Others believed that the volcanics intruded the granodiorite or were deposited on an eroded surface of granodiorite. These views might be harmonized by postulating two periods of volcanism, one pre- and one post-granite, or two periods of granite intrusion or both.

The excursion was attended by 110 individuals representing 21 institutions as follows: Bates, 3; Boston Teachers' School of Science, 17; Brooklyn College, 1; Brown, 3; Clark, 4; Colby, 3; College of the City of New York, 2; Columbia, 2; Dartmouth, 3; Framingham Teachers College, 1; Geological Society of America, 1; Harvard, 18; Massachusetts Institute of Technology, 19; Mount Holyoke, 3; Smith, 3; Tufts, 18; University of Maine, 1; University of Pennsylvania, 1; Wellesley, 2; Wesleyan, 2; Worcester Polytechnic Institute, 1; miscellaneous, 2.

EDWARD H. PERKINS,
Secretary

COLBY COLLEGE

WORK OF THE ROCKEFELLER INSTITUTE IN THE MEDICAL AND NATURAL SCIENCES

OPERATING on a budget of $2,200,000 for public health activities, The Rockefeller Foundation in 1934 engaged in field research on yellow fever, malaria, hookworm disease, tuberculosis, undulant fever, yaws and diphtheria; conducted yellow fever surveys and control campaigns; carried out projects in malaria control, supported numerous demonstrations of complete public health programs; gave aid to the organization or maintenance of essential services of state and national health departments, and continued its contribution for the training of public health personnel through aid to schools and institutes of hygiene and public health as well as by support of a fellowship program.

The total amount appropriated during the year for work in the medical sciences was $1,026,200. Aid of four types was given for the advancement of psychiatry: grants to universities and other institutions for the development of research and teaching in psychiatry and associated subjects; endowment and building funds for establishing psychiatric departments; research aid grants to individual workers engaged in important investigations in mental diseases, and fellowships to enable men and women especially qualified for work in this field to obtain desirable advanced training.

Grants for work in psychiatry were made to McGill University for research and teaching; to the Massachusetts Department of Mental Diseases for studies in psychiatry at the Boston State Hospital; to the Worcester State Hospital, Massachusetts, for research on dementia praecox; to the Johns Hopkins University, for the development of child psychiatry in the Pediatric Clinic; to the University of Leiden, for child psychiatry; to the Chicago Area Project, for the study, treatment and prevention of juvenile delinquency within a few selected areas in Chicago; to the University of Rochester, for the Child Guidance Clinic; to the National Committee for Mental Hygiene, towards support of its general expenses during 1935; to the University of Colorado, for the teaching of psychiatry in the Medical School; to the University of Michigan and the Institute of the Pennsylvania Hospital, for the development of teaching and research in psychiatry.

For work in neurology and related subjects, gifts were made to New York University, to Northwestern University Medical School, the University of Pennsylvania, the Walter and Eliza Hall Institute of Research in Pathology and Medicine, Melbourne, Australia; Dartmouth College and the Lister Institute of Preventive Medicine, London.

In the field of the natural sciences, appropriations made during 1934 amounted to $1,051,210. The program called for specific concentration in the fields of experimental and physicochemical biology, and included appropriations to: Amherst College, for research in biology; New York State College of Agriculture, Cornell University, for the support of a maize stocks clearing house; American Society of Naturalists, Carnegie Institution Laboratory at Cold Spring Harbor, Long Island, for a *Drosophila* stock center; Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine, for research in mammalian genetics; Harvard Medical School and Massachusetts Institute of Technology, for carrying out investigations in spectroscopic analysis of blood serum in anemia; Leland Stanford, Jr., University, for work in chemophysical biology; McGill University, Departments of Neurology and Physics, for research in spectroscopic biology; University of Chicago, to widen the scope of spectroscopic methods as applied to biological problems; University of Michigan, for research in biophysics; University of Uppsala, Sweden, for conducting research in the physicochemical properties of proteins; California Institute of Technology, for research in chemistry; Columbia University, to aid in conducting researches on the biological effects of heavy hydrogen; Columbia University, for research in the physiology of sex; National Research Council, for projects under the Committee for Research in Problems of Sex; Ohio State University, for research in endocrinology; State University of Iowa, for research in cellular physiology; University of Rochester, for studies on the physiology of reproduction; University of Wisconsin, for research work in endocrinology; University of Michigan, to conduct studies on the physiology of respiration.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences will hold its autumn meeting at the University of Virginia, on November 18, 19 and 20, under the presidency of Dr. Frank R. Lillie, who was elected at the spring meeting to succeed Dr. W. W. Campbell as president of the academy. This is the first meeting of the academy to be held in the South since its establishment in 1863.

DR. SAMUEL C. LIND, professor of physical chemistry and director of the School of Chemistry of the University of Minnesota since 1926, has been elected dean of the newly established Institute of Technology and took office on November 1. The institute consists of the College of Engineering and Architecture, the School of Chemistry and the School of Mines and

Metallurgy. The various schools will retain their own faculties, each with a director or assistant dean as administrative head.

DR. DONNEL F. HEWETT has been appointed geologist in charge of the Section of Metalliferous Deposits of the U. S. Geological Survey, to succeed Dr. G. F. Loughlin, who is now chief geologist. Dr. Hewett, an authority on economic geology, mineral economics and mineral reserves, is also a specialist on manganese and has given much attention to its discovery and development. He has been a member of the staff of the survey since 1911.

AT Christ's College, University of Cambridge, the following members of the college have been elected honorary fellows: Professor Arthur Hutchinson, master of Pembroke College and emeritus professor of mineralogy; Professor John Graham Kerr, emeritus professor of zoology, University of Glasgow, formerly fellow of the college; Professor George Henry Falkiner Nuttall, emeritus professor of biology and director of the Molteno Institute of Parasitology, formerly fellow of the college, and Dr. Arthur William Rogers, lately director of the Geological Survey, Union of South Africa, president of the Royal Society of South Africa.

DR. JOHN MELLANBY, professor of physiology at the St. Thomas Hospital Medical School, University of London, has been appointed to the Waynflete professorship of physiology at the University of Oxford, to hold office from January 1, 1936. He succeeds Sir Charles Sherrington, who had been Waynflete professor since 1913.

THE title of emeritus professor of bacteriology has been conferred by the University of London on Dr. J. W. H. Eyre, formerly university professor of bacteriology at Guy's Hospital Medical School; and that of emeritus professor of civil engineering on A. H. Jameson, who recently retired from the university chair of civil engineering at King's College.

THE Faculty of Engineering of the University of London has elected Professor Leonard Bairstow, dean for the remainder of the period 1934–36, in the place of Professor A. H. Jameson, who has resigned.

ON the occasion of the installation on December 2 of Sir Austen Chamberlain as chancellor of the University of Leeds, the degree of doctor of science will be conferred on Sir Frederick Gowland Hopkins, Lord Rutherford and Sir Joseph J. Thomson.

Nature reports that the annual Harveian Oration was delivered on October 18 at the Royal College of Physicians by Sir Henry Dale, director of the National Institute for Medical Research, whose subject was "Some Epochs in Medical Research." The president of the Royal College of Physicians, Lord Dawson of Penn, afterwards presented the Baly Gold Medal to Dr. F. H. A. Marshall and the Bisset-Hawkins Gold Medal to Sir George Newman, lately chief medical officer of the Ministry of Health. The Baly Medal is awarded annually for distinction achieved in the science of physiology. The Bisset-Hawkins Medal is awarded triennially for "such work in advancing sanitary science or in promoting public health as in the opinion of the college deserves special recognition."

THE Sudhoff medal has been awarded by the German Society of the History of Medicine to Professor Wilhelm Haberling, of the Düsseldorf Academy of Medicine and joint editor of *Mitteilungen zur Geschichte der Medizin, der Naturwissenschaften und der Technik*.

PROFESSOR BERNARDO A. HOUSSAY, of the Institute of Physiology in the Faculty of Medicine of the University of Buenos Aires, has been appointed a member of the Permanent International Committee of the Physiological Congresses. Recently a jubilee volume of the *Revista de la Sociedad argentina de Biologia* was published in Buenos Aires in his honor. It contains a full account of his writings and a number of articles on his work by various distinguished contributors.

DR. CYRUS H. FISKE has been promoted from associate professor to professor of biological chemistry at the Harvard Medical School.

DR. RICHARD E. SCAMMON, formerly dean of the medical sciences at the University of Minnesota, has been appointed to a distinguished research professorship, a chair especially created for him. Dr. Scammon has been on the staff of the University of Minnesota for twenty-five years.

DR. ROBERT H. WOODWORTH, who resigned at the end of the last academic year as assistant professor of botany and tutor in the Division of Biology and as curator of the Botanic Garden at Harvard University, has become a member of the faculty of Bennington College, Vermont.

DR. KONRAD E. BIRKHAUG, from 1925 to 1932 associate professor of bacteriology at the School of Medicine and Dentistry of the University of Rochester and for the past three years a member of the Institut Pasteur at Paris, has recently been called to a chair of experimental medicine which has been created for him at the Chr. Michelsens Institutt for Scientific Investigations at Bergen, Norway. He plans to carry on investigation in experimental tuberculosis and leprosy.

DR. BURTON K. KILBOURNE, health officer of Fargo, N. D., since 1923, has been appointed epidemiologist to the Montana State Board of Health at Helena, effective October 1.

THE Canadian Government has agreed to lend the services of Professor S. A. Cudmore, of the Bureau of Statistics, to the Government of Palestine for three years in order to organize a bureau of statistics.

THE Committee on Scientific Research of the American Medical Association has made a grant-in-aid to Dr. George D. Snell, of the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me., for studies on the effect of x-rays in modifying the germ plasm of mammals.

DR. A. S. PEARSE, professor of zoology at Duke University, has leave of absence. He is working on oyster parasites at Apalachicola, Fla.

DR. CHI-TING KWEI, dean of Yale-in-China School of Science, Central China College, Wuchang, who is at present on sabbatical leave in the United States, is spending several months at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, engaged in research work in terrestrial magnetism and electricity.

W. H. W. KOMP, entomologist of the U. S. Public Health Service, recently returned from Colombia, where he spent three months on a mosquito survey for the Rockefeller Foundation, in connection with the new problem of jungle yellow fever.

PROFESSOR EMERITUS GILBERT D. HARRIS, of the department of geology at Cornell University, and a former student, A. A. Olsen, have left by car for the South Atlantic and Gulf States where they expect to collect representative fossils from the Cenozoic deposits. They plan to visit Tennessee, Alabama, South Carolina and Mississippi, where they will visit the Cenozoic outcrops at Wauttubbe.

AFTER fourteen months spent at the Field Museum, Chicago, Dr. Charles Baehni, of the Botanical Garden of Geneva, Switzerland, returned to Europe recently. While in Chicago, he studied the American flora, especially the Sapotaceae or sapodilla family. In addition, he assembled duplicate material to be sent to the Geneva Herbarium, as the result of a cooperative project arranged by the museum with Dr. B. P. G. Hochreutiner, director of the garden.

DR. MAX VON LAUE, professor of theoretical physics at the University of Berlin, who has been lecturing at the Institute of Advanced Study at Princeton and at the Johns Hopkins University, gave a lecture on November 4 on "Thermo-Dynamic Fluctuations" before the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

DR. JOHN DE J. PEMBERTON, associate professor of surgery in the University of Minnesota Graduate School of Medicine, Rochester, gave the annual Mayo lecture of Northwestern University on November 15. His subject was "The Development of Thyroid Surgery."

DR. J. O. PERRINE, associate editor of the *Bell System Technical Journal,* addressed an open meeting sponsored by the Pennsylvania State College Chapters of Sigma Xi and Sigma Pi Sigma on the evening of October 31. The subject of his address was "Speech, Music and Electricity."

AT a meeting to be held in the auditorium of Metal Products Exhibits, International Building, Rockefeller Center, New York, on Friday, December 13, at 8 o'clock, "Steel Alloys" will be discussed by Dr. John Johnston, director of research, United States Steel Corporation, and H. W. McQuaid, of the Republic Steel Corporation. The meeting is under the sponsorship of The American Institute. Frederick B. Hufnagel, president of the Crucible Steel Company of America, will preside.

THE third International Congress of Comparative Pathology will be held in Athens from April 15 to 18, 1936, under the presidency of Professor W. Bensis, of Paris. In connection with the congress a twelve-day cruise will be organized, beginning on April 11 at Venice, allowing attendance at the congress sessions, and thereafter continuing until April 23, when Venice will be reached again. The places to be visited include Mount Athos, Nauplia, Olympia, Delphi, Mycenae, Corinth, Tiryns and Sparta.

THE three hundred and twenty-sixth regular meeting of the American Mathematical Society will be held at the University of Kentucky on November 29 and 30. The local committee in charge of arrangements for the meeting will consist of Dr. Paul P. Boyd, dean of the College of Arts and Sciences at the University of Kentucky and head of the department of mathematics, chairman, and Professor C. G. Latimer, Dr. H. H. Downing, Dr. L. W. Cohen and Dr. Flora E. Le Stourgeon, members of the committee. Sessions are planned for Friday morning and afternoon and Saturday morning, and Professor C. G. Latimer, of the University of Kentucky, has been invited to address the society on "The Arithmetic of Generalized Quaternions." A dinner for members and their guests will be held on Friday evening at the Lafayette Hotel, which hotel will be headquarters for the meeting.

THE fall meeting of the Central New York State Branch of the Society of American Bacteriologists will be held on November 23, at the New York Agricultural Experiment Station, at Geneva.

THE section of chemistry of the American Association for the Advancement of Science will hold sessions in St. Louis on Wednesday and Thursday, Janu-

ary 1 and 2. On Wednesday January 1, at 2:00 P. M. there will be a joint session with Section Q (Education) and with the cooperation of the Division of Chemical Education of the American Chemical Society for the second of a series of three symposia on the relationships of the science of chemistry to education. The subject will be "The Teaching of Chemistry." On January 2 there will be sessions for contributed papers both morning and afternoon. Titles and short abstracts of contributions for these sessions will be accepted by the secretary, J. H. Simons, Pond Chemical Laboratory, Pennsylvania State College, State College, Pa. It is urged that these be received on or before December 1. In the evening there will be a dinner arranged by the St. Louis Section of the American Chemical Society. Following the dinner the address of the retiring vice-president of the section, Professor Joel H. Hildebrand, will be given.

THE School of Mathematics of the Institute for Advanced Study each year allocates a small number of stipends to gifted young mathematicians and mathematical physicists for the purpose of enabling them to broaden their scientific outlook and to work on research programs at Princeton in contact with the members of the institute and university faculties. Only such candidates will be considered as have already given evidence of ability in independent research comparable at least with that expected for the degree of doctor of philosophy. Applications for the academic year 1936–37 should be filed before February 1, 1936. Blanks for this purpose may be obtained from School of Mathematics, The Institute for Advanced Study, Fine Hall, Princeton, N. J.

The Experiment Station Record states that the Florida state appropriation for the Citrus Substation at Lake Alfred has been increased from $11,451 to $46,451. A 40-acre tract of land and $650 have also been given by the Florida Agricultural Research Institute for the development of the citrus work.

The American Agriculturist, the oldest farm paper in America and for years conducted at Cornell University, henceforth will devote its profits to the betterment of agriculture and farm life. Frank E. Gannett and H. Edward Babcock, university trustees; Edward R. Eastman, former trustee, and E. Curry Weatherby, are giving outright their entire common stock control to American Agriculturist Research Foundation, Inc. This new foundation will control the paper, and its charter provides that the profits shall be used "for improving the economic condition and promoting the social well-being and happiness of those who dwell upon the land." Subscribers to the paper will elect three of the seven directors. Three are *ex officio*—the editor, Eastman; the circulation manager, Weatherby, and the advertising manager, Irving W. Ingalls. These six will elect the seventh, who will be chairman of the board. *The American Agriculturist* was formerly owned by Henry Morgenthau, Jr., now Secretary of the Treasury.

AT a congregation of the University of Oxford on October 22 the principal of Hertford introduced a series of decrees to make effective the allocation of £5,000 for five years by the Rockefeller Institute for Research in Social Science. An institute of statistics is being established, of which the reader in statistics, J. Marschak, has been appointed director. Research lectureships have been created as follows: In human geography, for E. W. Gilbert, Hertford; in colonial administration, for Miss Perham, research fellow of St. Hugh's; in public administration, for G. Montagu Harris, New College; in public finance, for R. F. Bretherton, fellow of Wadham. A lectureship in African sociology was also created, the appointment to which will be announced later. The principal pointed out that these lectureships should provide for a cooperative system of research in the social sciences, while the Institute of Statistics would be available as a central laboratory.

COMPLETE film copies of the NRA and AAA hearings, which, if put in book form, would amount to 556 bound volumes of 500 pages each, have been used for the first time by university research workers. Until a projector was developed, there had been considerable doubt about the method of using this historical research material. The cost of reproducing the hearings in printed book form was so large that the Federal Government could not undertake to print them, but when reproduced on 16-millimeter safety-film—at a cost of a little more than one mill a page—these records are inexpensive, permanent and space saving, occupying less than three feet of space. Not produced at government expense, the films were planned, executed and paid for by the Joint Committee on Materials for Research of the American Council of Learned Societies and the Social Science Research Council.

JOHN D. ROCKEFELLER, JR., formally presented to New York City on October 12 the Fort Tryon Park and Museum. The park, which covers a tract of 69 acres, overlooks the Hudson at 190th Street and Fort Washington Avenue and is valued at five million dollars. The gift includes The Cloisters, the collection of medieval art assembled by George Grey Barnard, the sculptor.

The British Medical Journal writes editorially: "Dating from January 2, 1787, the College of Physicians of Philadelphia followed the example of the

Royal College of Physicians of London in some respects, such as having four censors of whom one is the senior, and in having moved its place of residence on several occasions. To celebrate the twenty-fifth anniversary of the last move Dr. G. E. de Schweinitz, the senior censor and former president, has, with the assistance of the librarian, revised and brought up to date the account of the college he wrote more than twenty years ago, when he was president for the usual span of three years. The college, which has about six hundred fellows all told, is fortunate in the generosity of its alumni, especially S. Weir Mitchell and W. W. Keen, and in its fine house has many 'private study rooms,' where the fellows and their guests, surrounded by the volumes they require, work without interruption. There are a number of rooms named after eminent benefactors, such as the Norris room, which contains more than twelve hundred current periodicals. The library, with 173,000 volumes, has for ten years purchased annually fifteen hundred books, and possesses more than four hundred incunabula. It is the proud owner of forty-four out of the fifty-four recorded editions of William Harvey's works, the copy of the Bologna edition (1697) of the 'De Motu Cordis' being the only one now known to exist. Another unique volume is Thomas Cadwalader's 'Essay on West India Dry Gripes,' with the original two prefaces, one of which was suppressed."

DISCUSSION

DISTRIBUTION AND UTILIZATION OF FLOOD WATERS

THE main objective of the Nakai Bito (Mexican Springs) Experiment Station is to increase the human carrying capacity of the Navajo lands, not only to where they will take care of the present increasing population, but to a point where they will provide a livable place for future generations. Since there are at this time some 45,000 Indians living on this land—and they must continue to stay on it, as there is no more land for them—it means that we who are in charge of the rehabilitation of the area must concentrate on a land management plan which will develop every natural resource to its fullest possibility.

Accelerated erosion is not only washing away the fertile lands, but it is causing the lowering of the water tables and changing the soil moisture tables so that vegetation has little chance of assimilating even a small part of the precipitation. The essential elements that go to make up the plant food in many places are far below the reach of the feeding roots of vegetation, and the moisture does not lie on the surface long enough to make available the foods necessary to sustain a ground cover. This applies to the cultivated lands which were normally—perhaps I should say formerly—used by the natives of this country.

The location of prehistoric ruins and the abandoned hogans of the present occupants of the Navajo country would indicate that the center of population was, at one time, in the big alluvial valleys. A recent survey of cultivated lands on and adjacent to the Mexican Springs Experiment Station showed that by far the greatest amount of land now farmed by the Navajos is in the mountain valleys up to, and even above, 8,000 feet in altitude. This change in the center of population has been brought about by erosion, and this erosion has been caused by the destruction of the vegetative covering on the steep slopes, thus creating an abnormal concentration of water in the water courses.

A number of old Navajos have told me that as recently as twenty-five years ago they cultivated farms on the deltas of the Nakai Bito Wash. Now its precipitous sides are from twenty to thirty feet deep. Now there is a perfect drainage system created by two parallel washes and several laterals leading out through the deep alluvial soil of the valley. Since the destruction of this land was brought about by the concentration of water which should have been normally distributed and absorbed, we are attacking the problem by preventing as nearly as possible the concentrating of water, using diversion dams and spreading systems which will, we believe, not only distribute it over a very large area but will actually hold it until the soils can absorb it. This network of flood water utilization devices is being put into effect wherever it is possible to find a level piece of land or a gentle slope where waters can be diverted from the channel. It may be not more than a quarter of an acre at the head of a watershed, or it may be a thousand acres in a wide-spreading valley; but the idea is at all times to keep the water from ever reaching the main water course except via the underground passage.

The water may be spread by means of earthen dikes which may be, in some cases, a mile in length with weep-holes at intervals to carry a given amount of water; or it may be spread by a diversion dam with a submerged rock spillway from 200 to 600 feet long and built on a dead level so that the water will not be able to "pile up" as it proceeds down the valley. At certain danger points where the water might concentrate, smaller earthen dikes are built, or woven wire

fences, burlap-covered, are erected to get a better distribution. Meanwhile, the growing vegetation begins to bind the soil so that, with conservative utilization of plant life, there is little danger of washing after the first year.

Last year, the volume production of grass below one such diversion dam on our project was increased to nearly five times that on adjoining lands where no water was spread. The production in a Navajo corn field receiving flood irrigation through this water-spreading device was increased from a probable twenty bushels to about forty bushels per acre.

The cost of collecting and distributing these flood waters is comparatively small, amounting to but a few dollars per acre. The effects are far reaching. The washes from this eroded area carry a silt content of from twenty-five to thirty per cent. In the natural course of events, this is dumped into the San Juan River, and from there into the Colorado. It doesn't take much imagination to see what this constant depositing will do to the Boulder Dam. Engineers have stated that the very life of the dam depends upon the amount of silt deposited above it, and by far the greater part of it probably comes from the watershed of the San Juan and the Little Colorado Rivers. It is gratifying to know that while we are striving primarily to rehabilitate the lands for the Navajo, we are at the same time helping in the preservation of one of the greatest irrigation projects in the United States.

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NAMING POTTERY TYPES, AND RULES OF PRIORITY

IT is a curious psychological fact that a pottery type with a name can be visualized. One without a name seems intangible. As an example, two-color yellow ware means little, whereas Sitkiatki polychrome to the initiated brings up a distinct picture in the mind, a picture of all the attributes of the type. Besides, a type with a name can be referred to without repeating a partial description every time it is mentioned. These are the reasons for naming pottery types, and the method proposed at Pecos Conference in 1927 (SCIENCE, 66: 489) seems to be the best method and has in consequence been widely accepted. But we must go farther than that.

The necessity for having rules to follow in the naming of pottery is evident from the large synonymy that has developed. In the Southwest about 250 pottery types have been described. In one ware, which contains sixteen types, there are fifty-four synonyms, making seventy names to be remembered by an investigator working on that ware. One type, Flagstaff Black-on-white, has seven synonyms. Almost every author that has worked in the Southwest has felt free to give names as the whim pleased him, without reference to what has been done in the past, and one author has called the same pottery type three different names in three different publications. The need for a system is evident.

The authors of this paper are working on a handbook of northern Arizona pottery types and propose the following rules to determine the name that they will use. As these rules follow, in general, those that have been developed by biologists since the time of Linnaeus we see no reason that they can not, in a modified form, be applied to ceramics. Certainly some sort of a system is necessary.

In order to prevent a useless duplication of the names of pottery types we propose the following rules:

(1) A name of a type consists of a geographical name, followed by a descriptive term. Example: Sitkiatki Polychrome. This binomial principle was decided at the 1927 Pecos Conference (SCIENCE, 66: 489, 1927). Gladwin and Gladwin (Medallion Papers, No. 7, 1930) state that "the geographical name need not be the spot where the type was first found, nor its area of greatest density but would simply serve as a label for reference." This idea can not be too greatly stressed. Many feel that if a type is named for some place on the periphery of its area of distribution it should be changed, as our knowledge increases, to a locality in the center of the area. This only leads to endless confusion and a useless synonym. The first name given, if properly constructed, and, if the description is clear, should stand.

(2) The geographic name must not be combined with a prefix (Example: Proto-Kayenta) or a comparative adjective (Upper Gila) except where a prefix or an adjective has become an accepted part of the geographic name (Little Colorado).

(3) Names should be short (Chaco) and unwieldy geographic names can be abbreviated (Kokopnyama becomes Kokop). Unnecessary adjectives should be omitted (North Creek Gray Corrugated becomes North Creek Corrugated).

(4) Any name of a pottery type given before the Pecos Conference of 1927 is credited to an author if a geographic name is inferred with a descriptive term. Example: Nordenskiold ("Cliff Dwellers of Mesa Verde," 1893, p. 83) has accurately described and figured a type from Mesa Verde, which he calls Black and white ware. Kidder ("Southwestern Archaeology," 1924) calls it Mesa Verde Black-on-white, which is properly constructed on the binomial

system, although Nordenskiold's name is not. By inference Nordenskiold has named the type. If a question of priority should arise 1893 should be the date —not 1924.

(5) The type must be sufficiently well described that the description does not conflict with the description of any other type.

(6) A name printed without a description should be ignored.

(7) The date of acceptance of a manuscript for publication, when printed in a journal, supersedes the date of publication of the journal in matters of priority.

(8) The name and description of a new type, to be accepted, must be printed, lithoprinted or mimeographed, and not less than fifty copies distributed to libraries of anthropological laboratories and workers in the field.

(9) As suggested by Gladwin and Gladwin (1930) when a type is named sherds and, if available, whole vessels should be designated type specimens and set aside for future comparison.

The authors of this paper would be glad to receive comments on the above rules.

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THE INHIBITING INFLUENCE OF A VIRUS ON ONE OF ITS MUTANTS

SEVERAL years ago the writer[1] called attention to the fact that when tobacco plants showing the symptoms of the common mosaic (referred to as light-green mosaic) were reinoculated with the virus of a yellow mosaic, which is considered to be a mutant of the former, no change in the symptoms occurred.

The writer inoculated tobacco plants with virus mixtures in which the virus extract of the yellow mosaic was 999 times more concentrated than the virus extract of common mosaic. All the inoculated plants developed symptoms of yellow mosaic. However, 47 days after inoculation the young leaves were showing the symptoms of common mosaic. Other plants, inoculated at the same time with mixtures containing 499 parts and 99 parts of the extract from yellow-mosaic plants, also developed symptoms of yellow mosaic, but the common mosaic symptoms made their appearance earlier than 47 days.

Tobacco plants having yellow mosaic were reinoculated with the purest virus of common mosaic obtainable. From 5 to 20 leaves which developed after this reinoculation developed yellow mosaic, then from 8 to 25 leaves developed progressively less yellow mosaic in combination with common mosaic until the subsequent foliage developed only typical common mosaic. Suckers from such plants developed the typical symptoms of common mosaic. Some of the first few leaves which manifested only the light and dark-green mottling carried a small amount of the virus of yellow mosaic. However, subsequent leaves were free of detectable amounts of yellow-mosaic virus, except in cases where the small yellow-mosaic mutation spots occurred and in such cases the virus of yellow mosaic was confined to these spots and the adjacent tissue.

Other workers have found that certain yellow-mosaic viruses which induce necrotic lesions in suitable species will not induce these lesions if the plants have been previously infected with certain leaf-mottling viruses.

This phenomenon has been referred to as acquired immunity[2, 3] and as induced immunity.[4] On this basis the virus of common mosaic may be looked upon as an immunizing agent or "vaccine" and from the evidence presented in the second and third paragraphs it appears that we are dealing with a condition of incompatibility in which the "vaccine" virus eventually suppresses the yellow-mosaic virus in the meristematic tissues. This interpretation makes it unnecessary to assume that the "vaccine" virus induces the plant to set up a special defence mechanism which in turn combats the virus of yellow mosaic.

It appears that the virus of common mosaic represents a rather low or primitive form of "vaccine," since the disease induced by it becomes permanent and is a distinct menace to the plant during its life under normal cultural conditions. On the other hand, the virus seems to represent a uniquely high type of "vaccine," since it suppresses the development of the yellow-mosaic virus and ultimately induces what possibly may be considered a cure for yellow mosaic in those parts of the plant which are formed after the original yellow-mosaic virus has been sufficiently reduced. The *G* virus used in Salaman's[5] tests against the *L* virus in tobacco and *Datura stramonium* is a more efficient "vaccine" since it induces very slight symptoms with no appreciable effect on the health of the plants. It is possible that virus mutants may be isolated which will protect as well as "cure" and yet not survive indefinitely in an active form in the plant.

The inhibiting characteristic of the common-mosaic virus is regarded as one of the strongest lines of evidence in support of the view that the occasional small yellow-mosaic spots[1] which have been associated with common mosaic in all the 5,000 or more tobacco plants studied by the writer resulted not from viruses intro-

[1] H. H. McKinney, *Jour. Agr. Research*, 39: 557, 1929.

[2] L. O. Kunkel, *Phytopathology*, 24: 437, 1934.

[3] W. C. Price, *Phytopathology*, 25: 776, 1935.

[4] John Caldwell, *Proc. Roy. Soc.*, Ser. B 117: 120, 1935.

[5] Redcliffe N. Salaman, *Nature*, 131: 468, 1933.

duced from the outside, but from viruses which originated as mutants in the tissues involved in the spots.

It was pointed out in an earlier paper[1] that plants having pure yellow mosaic are rarely observed in commercial tobacco and tomato fields, and they were rarely seen among the many mosaic-diseased *Nicotiana glauca* plants growing in the Canary Islands. These observations are now explained on the basis that the common-mosaic virus greatly restricts the size of the yellow-mosaic mutation spots and also the amount of the yellow-mosaic virus, thus decreasing the chances for its spread to other plants. A relatively large amount of the common-mosaic virus is thus maintained in the infected plants and this virus prevents the establishment of tobacco yellow-mosaic virus which might enter these plants from the outside.

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IODINE THERAPY AND GOITRE

MAY I add a mite[1] with respect to the early history in the use of iodine in the successful treatment of (endemic) goiter. I refer to Moses Gunn's (1822–1891) famous prescription, which every Rush Medical College graduate is quite familiar with.

Dr. Moses Gunn went to Rush Medical College Chicago, Ill., (from Ann Arbor, Michigan), in 1867, as head of the department of surgery and as the successor to Dr. Daniel Brainard.[2] Finding a high incidence of goiter in the Chicago area he prescribed his now famous "three eight" mixture, as follows:

℞
Iodi ..... gr. viii
Potassii iodidi ..... ʒ viii
Syrupi sarsaparillae ad f ..... ℥ viii

No doubt the supposedly "alterative" action of iodine was uppermost in the mind of Dr. Moses Gunn. At any rate, this early practitioner noted the beneficial effects of iodine therapy in the treatment of hyperplastic goiter. And, it should be noted, long before Marine (1907) put iodine therapy for this condition on a truly scientific basis!

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SPECIAL ARTICLES

THE EFFECT OF ALTERATION ON THE LEAD–URANIUM RATIO AND THE CALCULATED AGE OF WILBERFORCE, ONTARIO, URANINITE

IN order to determine the effect of leaching on the lead-uranium ratio of uraninite, a determination of the lead, uranium and thorium content of three zones of a single crystal of Wilberforce, Ontario, uraninite has been made. Instead of grinding a large specimen of the mineral to uniformity and analyzing the then homogeneous material, as is usually done in age determinations, a method of carefully removing successive layers from the crystal was used, followed by analysis of the outermost layer, middle layer and innermost layer or core.

A crystal weighing about twenty-four grams was selected. It was apparently altered to some extent, as the color was reddish brown, although the cubo-octahedral structure of the crystal was still intact, this in spite of the great age of the mineral and the large amount of lead which had been generated in the crystal since its formation.

The crystal, which had previously been cleaned from any superfluous material, was weighed, treated with dilute nitric acid until approximately one third of the mass was removed, washed, dried and reweighed. The remainder of the crystal was gently treated with acid until another third was dissolved. Finally, the core was dissolved. Aliquot portions of each of these resulting solutions were analyzed for lead, uranium and thorium by methods which will be described in a later paper.

The outside section included all of a shell, perhaps from one to two millimeters thick, of highly altered material which covered the entire surface of the crystal and some of the black material which constituted the remainder of the crystal. All the middle layer and core appeared homogeneous and pure black in color.

From the data obtained from these analyses, the "lead ratio" and the corresponding age of each section of the crystal could be calculated by means of the formula:

$$\text{Approximate age} = \frac{\text{Pb}}{\text{U} + 0.36\ \text{Th}} \times 7600 \text{ million years}$$

The age as calculated by this approximate formula is somewhat higher than that given by the more exact logarithmic formula, but is used here in order that it may be compared with the results of earlier investigations of the age of this mineral.

The average results of several analyses of each section are given in the following table:

[1] McCay, SCIENCE, 82: 2128, 350, 1935; McClure, SCIENCE, 82: 2129, 370, 1935.

[2] "History of Medicine and Surgery and Physicians and Surgeons of Chicago, 1803–1922," p. 61. The Biographical Publishing Co., 133 W. Washington Street, Chicago, Ill., 1922.

Section of crystal	Lead Per cent.	Uranium Per cent.	Thorium Per cent.	$\frac{Pb}{U+0.36\ Th}$	Approximate age in million years
Outside layer	9.74	37.85	8.36	0.238	....
Middle layer.	11.93	58.48	14.09	.188	1,427
Core	11.87	60.70	8.05	.187	1,418
Whole crystal	11.13	47.73	9.55	.218	....

From the results it seems that, in the long process of alteration, uranium has been removed faster than lead. This is in agreement with the general belief that ages based on analyses of altered minerals are too great.

A study of the composition of the two inner layers, both of which were apparently unaltered, and certainly were both of the same geologic age, is most interesting. The lead content is nearly constant. The fact that the thorium content of the core is considerably less than that of the middle layer is surprising. It is possible that, during the formation of the crystal which probably required only a comparatively short time, the concentration of the thorium increased in respect to uranium. If that be true then the low value for thorium in the outside layer must be attributed to leaching.

The value of the "k factor," which converts the thorium content to an equivalent amount of uranium in lead-producing capacity, must be such that the ratio calculated for minerals of the same age but with varying amounts of uranium and thorium will be the same. Since the thorium and uranium contents are not the same in the two inner sections of this mineral, all of which must be of the same approximate age, the value of this "k factor" can be calculated from the analytical data.

$$\frac{Pb\ (middle)}{U\ (middle) + k\ Th\ (middle)} = \frac{Pb\ (core)}{U\ (core) + k\ Th\ (core)}$$

Substituting the values for Pb, U and Th from the table, k is found to be 0.42. This is somewhat higher than 0.36, which is commonly accepted as the most probable value for this constant. Due to the lack of proof that alteration has not affected the composition of these inner layers, little weight can be given this calculated value of k.

It has been suggested by Professor Alfred C. Lane[1] that, if, during the formation of the crystal in the pegmatite, there was a transfer of uranium into veins where we find it as botryoidal pitchblende uniformly free from thorium, we might expect a greater proportion of thorium in the middle layer of the crystal, and this would, perhaps, account for the higher k factor and slightly higher lead ratio than was found for the much larger crystal of Wilberforce uraninite analyzed by Wells and used by Baxter and Bliss[2] for atomic weight determinations of lead.

[1] Private communication.

CONCLUSIONS

From the data at hand, the following conclusions are suggested.

In the alteration of uraninite, lead is lost less rapidly than uranium and thorium.

In order to calculate accurately the age of a mineral by the so-called lead method, it is necessary to have analytical data on fresh, unaltered specimens.

Since most uraninites and pitchblendes are altered to some extent, the calculated ages are likely to be too great.

The Th/U ratio in different zones of a single crystal of uraninite may vary. This, in the case of unaltered uraninites, may be due to a change in concentration, during the growth of the crystal, of these elements in the medium in which the crystal was produced.

Assuming no alteration in the two inner zones of the specimen analyzed, the lead-uranium ratio leads to a value of about 1,420 million years for the age of this mineral. This is only slightly higher than the results of other investigators for the age of Wilberforce, Ontario, uraninite.

A method is suggested for calculating the relative lead-producing power of uranium and thorium from the analytical data on sections of single crystals of minerals in which the Th/U ratio varies, due to some other process than alteration.

Further study of the effect of alteration on the lead ratio of radioactive minerals is in progress by one of the authors.

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APPARENT INTOXICATION IN POULTRY DUE TO NITROGENOUS BASES

DURING a series of experiments upon commercial protein supplements we observed a condition in poultry which we believe to be an intoxication induced by nitrogenous bases. The diet upon which the symptoms were observed contained yellow corn 64, wheat 20, functionally low sulfur fish meal 10, dried yeast 1, calcium carbonate 1.1, tricalcium phosphate 0.4, and sardine or cod liver oil 1 part. It will be noticed that this ration is similar to the one employed by Holst and Halbrook[1] in their studies upon "scurvy-like" disease in chicks, with the exception that the concentration of the protein supplement is here within normal limits for growing chicks.

[2] Baxter and Bliss, *Jour. Am. Chem. Soc.*, 52: 4851, 1930.

[1] W. F. Holst and E. R. Halbrook, SCIENCE, 77: 354, 1933.

The general characteristics of the syndrome can be described as follows: (1) There was an anemia which in some cases was so severe that there remained less than 1.7 gm hemoglobin per 100 cc blood; (2) the clotting time of the blood was greatly lengthened; (3) the blood picture was distorted and was generally characterized by the presence of (a) immature red cells, (b) a high white count, which tends to become abnormally low if the bird becomes moribund as the result of weakness and ceases to eat or drink, (c) a fall in the percentage of polymorphonuclear leucocytes and a corresponding rise in the percentage of lymphocytes; (4) the striking occurrence of hemorrhages without respect to location. However, hemorrhages are not always observed upon birds of this type, even though the other symptoms may be present.

In order to obtain a hemorrhagic bird it must be placed upon an appropriate diet at an early age. When birds are placed upon a normal ration for the first few weeks of life, we have not been able to induce hemorrhages by subsequently feeding a hemorrhagic ration, although the blood picture may be as described above. This observation with respect to the occurrence of hemorrhage may explain the inability of Cribbet and Correll[2] to produce hemorrhagic symptoms in chicks with the Holst-Halbrook ration, since they did not begin to feed such a ration until the chicks were 25 days old. We have been able to produce the symptoms at will during the past two years, provided the birds were placed upon the hemorrhagic diet when 7 days of age, or younger.

A similar set of symptoms, including hemorrhages and low hemoglobin but not including the blood picture, was described by Holst and Halbrook as a scurvy-like disease, and they were of the opinion that it was due to the lack of vitamin C. Since scurvy-like symptoms may be induced by many liver poisons, such as fluorides, phosphorus, benzene, alkylamines and ergot, the occurrence of such symptoms does not necessarily indicate a lack of vitamin C. The hemorrhagic ration of Holst and Halbrook contained approximately 20 per cent. fish meal, and it is stated by them that a decrease in the percentage of fish meal by the addition of 10 per cent. dried skim milk produced almost normal chicks. Since it is extremely doubtful if dried skim milk contains any vitamin C,[3] it is hard to understand why the beneficial results appeared if the primary difficulty was due to the lack of vitamin C. Since we are able to show that at least a portion of the symptoms are due rather to the presence of nitrogenous bases in the functionally low sulfur fish meal fed, a more plausible explanation lies in the fact that fish meal concentration was lowered and in that manner the intake of nitrogenous bases was decreased.

A similar set of symptoms has been reported by Dam,[4] in this case induced by a diet composed of vitamin-free casein, marmite, cod liver oil concentrate, corn-starch and salts. However, the pathological symptoms of these birds as reported by Schönheyder[5] do not include morphological changes in the blood. Since we have always found a distorted blood picture whenever nitrogenous bases were administered and not detoxified, it is possible that we are dealing with both the anti-hemorrhagic factor as reported by Dam and in addition the effects of materials such as the nitrogenous bases.

The results of our investigation show that with a diet such as the one we used, the replacement of functionally low sulfur fish meal by meat scrap, casein, skim milk, or functionally high sulfur fish meal resulted in a definite decrease in hemorrhagic symptoms. We also observed that the addition to an otherwise non-hemorrhagic diet of trimethylamine, dimethylamine, monomethylamine, diethylamine, dipropylamine, isoamylamine, ergot and nicotine gave a set of symptoms similar to that produced by the hemorrhagic diet described above. We are also able to demonstrate quantities of bases, mainly methylamines, in composite samples of functionally low sulfur fish meal and in fresh specimens of the fish from which the meal was made which would be sufficient to produce the intoxication in the diet fed. Methylamines were also present in the functionally high sulfur fish meal, but owing to the nature and amounts of the sulfur compounds contained therein, detoxication was possible.

In looking for some method to counteract the presumed effect of the nitrogenous bases, we investigated the possibility of combining these substances with a haem compound in the presence of a reducing agent. (For it has been known since the work of Barcroft, Anson and Mirsky, and others, that compounds of this type combine easily with hemoglobin to form hemochromogens). When we added dried blood and certain sulfur-containing reducing agents (particularly elemental sulfur, cystine and cysteine) to hemorrhagic diets, such as those containing functionally low sulfur fish meal, alkylamines and ergot, a marked alleviation of symptoms was observed.

This investigation is not yet complete, but the data indicate that diets including such substances as certain of the nitrogenous bases may be detoxified by the administration of materials rich in sulfur-containing amino-acids or reducing agents contained in or derived from plant or animal materials plus some haem compound, if it is not otherwise present.

[2] R. Cribbet and J. T. Correll, SCIENCE, 79: 40, 1934.
[3] E. B. Hart, H. Steenbock and N. R. Ellis, *Jour. Biol. Chem.*, 46: 309, 1931.
[4] H. Dam, *Nature*, 135: 652, 1935.
[5] F. Schönheyder, *Nature*, 135: 652, 1935.

Further work is in progress, and the entire investigations will be reported in detail elsewhere.

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THE DIPHASIC ASPECT OF THE CURDLING OF MILK BY RENNIN

STUDIES of rennin action are all based upon the physical changes which it induces in milk or casein solutions. The end-point of the process is the appearance of a flocculent precipitate, the formation of a solid gel or the rise in viscosity immediately preceding these gross evidences of rennin activity. Added ions or compounds are found to accelerate or retard the process as a whole, and this is usually interpreted to indicate acceleration or inhibition of the enzyme. As a matter of fact, we may have marked change in curdling time without any change in the activity of the enzyme. It is clear that the curdling of milk involves two distinct phases. One is the enzymic phase, in which, according to Bosworth, casein is split into two molecules of paracasein. The other is the phase of aggregation, in which paracasein separates out as a precipitate or forms a gel. The two phases may be separated for the purpose of study in the following way.

To a standard milk preparation a small amount of rennin is added. Samples are removed at intervals; treated with formaldehyde to check the enzyme, and with sufficient calcium chloride to precipitate paracasein only. The volume of the paracasein is measured in a graduated centrifuge tube after whirling at a given speed for a given time. Nitrogen determined on the supernatant indicates accurately the residual casein left in the digest at the time of sampling. When plotted, the curves of paracasein increase and casein decrease are reciprocal. When paracasein reaches a constant and maximum volume, the supernatant liquid is perfectly clear and shows no casein N. This marks the end of the enzymic phase. The phase of aggregation ends when the paracasein precipitates or curds. The enzymic phase occupies less than 60 per cent. of the time required for the appearance of curd. From the data obtained, therefore, we may conclude that the digestion phase of curdling is over in about half the time required to develop the actual curd.

If calcium chloride is added to the milk, and a similar digest started, with accurate control of pH, the process as a whole is accelerated. When studied by the method outlined, it is found that the calcium salt has no effect upon the enzymic activity of rennin, but markedly shortens the time required for the precipitate or curd to form. On the other hand, an increase of the H ion accelerates both phases.

We expect to report later in more detail studies of the two phases involved in curdling of milk by rennin and other proteases.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TUBE FOR CULTURING FUNGI

IN connection with experimentation on the temperature and oxygen relations of growth and respiration in some wood-inhabiting fungi cultured on solid nutrient agar, a new form of culture tube has proved very satisfactory. It consists of the ordinary test-tube, modified by a rounded indentation or invagination of the wall on one side near the mouth, as shown in the accompanying diagram. This modification is

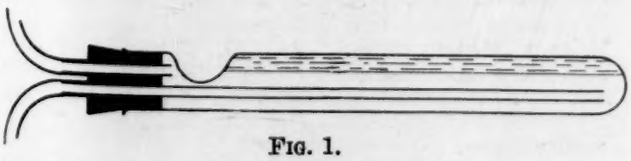

FIG. 1.

easily accomplished by holding the test-tube at right angles to the flame of a wing-top Bunsen burner until the portion of the wall which is to be altered is sufficiently softened, when gentle mouth suction is applied internally by means of rubber tubing attached to a bit of glass tubing that leads through a cork stopper set tightly into the test-tube opening. Finally, the heated portion should be subjected to a yellow flame to insure adequate annealing. With a suitable flame tubes of hard or other chemically resistant glass may be employed.

Such a modified tube is charged with agar substrate in the usual way, excepting that it is not slanted but is kept horizontal, with the indentation below, while the agar solidifies. Since the indentation prevents the escape of the agar while still liquid, there results a uniform narrow strip of solidified substrate (shaded in the diagram) lying along one side of the tube. The tube when thus prepared can be used for short-term growth studies with advantages noted by Fawcett in connection with his long-tube cultures of parasitic fungi.[1] Visible characteristics of growth may be studied by means of surface observations, or inspection through the substrate if the latter is reasonably

[1] H. S. Fawcett, *Ann. Appl. Biol.*, 12: 191–198. 1925.

clear. When viewed through the substrate, with suitable illumination, the progress of marginal growth can be accurately measured to 1 mm or better. When closed by means of the usual cotton plug this modified culture tube may be more satisfactory for many purposes than is the ordinary test-tube, Petri dish or standard Kolle flask.

In the writer's experiments ten culture tubes of this type, 2.5 cm in diameter and 20 cm long, are joined together and are operated as a single unit. Each tube is provided with a tightly fitted, 2-hole rubber stopper, bearing an inlet and an outlet tube, as shown in the diagram, so that any specified gas mixture may be passed continuously over the culture. The tubes are joined in series by short connections of rubber tubing. To prevent significant exchange of gas between inside and outside of the culture system and to reduce temperature fluctuations, the whole group is inverted and stands vertically in a water bath. The continuous gas stream not only maintains oxygen pressure practically the same for all cultures of a group, but it also insures the continuous removal of the CO_2 produced, which may be collected in absorption apparatus and measured from time to time in conjunction with the growth measurements.

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THE JOHNS HOPKINS UNIVERSITY

RAPID WEIGHINGS WITH A TROEMNER SOLUTION BALANCE

THOUSANDS of weighings have been made during the past five years with a 20-kilo capacity Troemner solution balance. To avoid the inconvenient, tiresome and time-consuming method of getting the eye on a level with the pointer-end of the beam in order to make a correct reading, two very simple, but very satisfactory, additions were made to the balance.

The two additions consist of a damper, as shown in Fig. 1, *a*, and two white strips attached to the adjacent projections on the swinging and stationary beams (Fig. 1, *b*). In the center of each of these strips a black line about 1 mm wide was drawn, the two separate black lines appearing as one continuous line when the weighing beam is exactly balanced. Black and white enamel paints could have been used. The parts of the damper are of glass and aluminum to prevent corrosion. The liquid is glycerine and may be diluted or not, as convenience demands. The vessel containing the glycerine is covered to exclude foreign matter, except for a small opening in the center of the cover through which the disk support passes. It does not show in the figure, but the upper

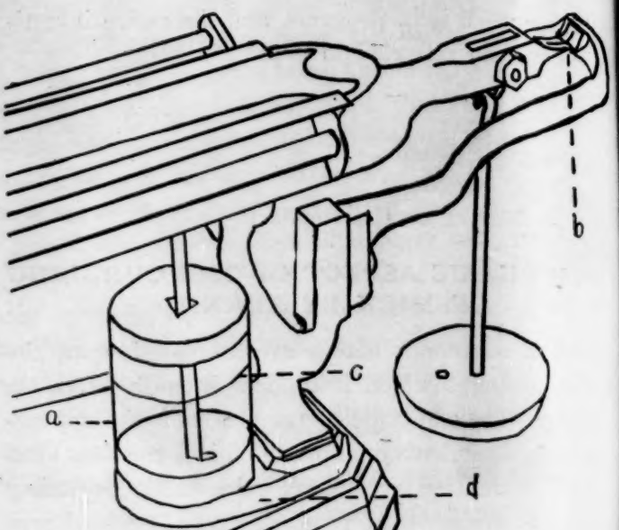

FIG. 1. Aids for reading Troemner solution balance: *a*, damper; *b*, black lines on white background; *c*, level of glycerine; *d*, tape to hold damper vessel in place.

end of the disk support is attached near the distal end of the rod which carries the adjusting rider.

Balance adjustments with objects weighing 15 or more kilos can be rapidly and accurately made to within 1 gram. It has proved helpful in making readings to provide a black background for the outer ends of the beams. This may be done by standing a black card on the table, allowing it to lean at right angles to and against the distal end of the stationary beam.

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BOOKS RECEIVED

ALLEN, EDWARD M. *America's Story as Told in Postage Stamps.* Pp. 199. McGraw-Hill. $2.50.

BORRADAILE, L. A. and F. A. POTTS and others. *The Invertebrata.* Pp. xv + 725. 483 figures. Cambridge University Press, Macmillan. $4.00.

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CLEAVES, H. E. and J. G. THOMPSON. *The Metal—Iron.* Pp. xii + 574. $6.00.

COMPTON, ARTHUR H. *The Freedom of Man.* Pp. x + 152. Yale University Press. $2.00.

DAMPIER-WHETHAM, W. C. D. and MARGARET DAMPIER-WHETHAM. *Cambridge Readings in the Literature of Science.* Second edition. Pp. 275. Cambridge University Press, Macmillan. $1.00.

FINDLAY, ALEXANDER. *The Teaching of Chemistry in the Universities of Aberdeen.* Pp. viii + 92. Aberdeen University Press.

GRIMSEHL, E. *A Textbook of Physics.* Vol. 5: *Physics of the Atom.* Pp. xiii + 474. Illustrated. Blackie and Son, London. 17s, 6d.

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